The FEEDING of CHICKENS

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THE FEEDING OF CHICKENS

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HOW CHICKENS USE THEIR FEED

THE CHICKEN is of value to man because it converts various plant and animal materials, which are not satisfactory as human food, into meat and eggs that are very desirable and nutritious foods. The process of conversion is one in which materials of relatively high carbohydrate content are changed into products of relatively high protein content. Moreover, the protein in the resulting meat and eggs is of better quality than that which was originally present in the feed of the chickens. Other changes also take place. Some of the carbohydrate in the feed is changed into fat, and much of this fat, as well as much of that in the feed, is deposited in the chicken's body or is used in the production of eggs.

Before the feed consumed by a chicken can be utilized, it first must be digested and absorbed. Digestion is essentially a process wherein the carbohydrates, fats, and proteins are split into simpler compounds which can be absorbed. This process takes place through the action of substances known as enzymes which are produced within the chicken's body. Ordinarily, only from 75 to 90 percent of the organic matter in the feed can be digested. The undigested portion and that part of the digested portion which cannot be utilized are excreted from the body in the droppings.

MAINTENANCE REQUIREMENTS

Not all the feed that is digested and absorbed is transformed into meat or eggs. Some must be used for maintenance. A portion of the absorbed nutrients is used as fuel to maintain the temperature of the body, to carry on the processes of digestion and absorption,

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and to supply energy for breathing, for the work of the heart, and for all other muscular activity. The percentage of the absorbed nutrients that is used for maintenance varies greatly with the age of the chicken, or with the rate of egg production, but is always rather large, except in the very young chick.

USE OF FEED FOR GROWTH

The growing chicken uses its feed less efficiently for growth as its live weight increases, because the maintenance requirement becomes larger as the chicken becomes heavier. Very young chickens may gain as much as four-tenths of a pound in live weight for each pound of feed they consume; but when chickens are almost fully grown they may require five or more times as much feed to make the same gain.

The change in efficiency of feed utilization with increase in live weight is shown by the fact that the second 5 pounds of feed consumed by a chicken of one of the heavier breeds produce only 80 to 85 percent as much gain as do the first 5 pounds. The third 5 pounds produce only 80 to 85 percent as much gain as do the second 5 pounds, and so on for each successive 5 pounds of feed. In the lighter breeds the efficiency of feed utilization decreases somewhat more rapidly than it does in the heavier breeds. In general, male chickens use their feed more efficiently for growth than do the females.

USE OF FEED FOR EGG PRODUCTION

Usually a pullet begins to lay before her growth is completed. This means that some of the feed consumed by a pullet during her first 4 or 4½ months of egg production is used for growth and that the remainder is used for maintenance and for producing eggs. In the yearling hen the feed is used chiefly for the last two purposes, but some is used for regaining the weight lost during the molt, which usually occurs during the last few months of the pullet year.

On an average, nearly 1⅓ ounces of water and 1½ ounces of feed, in addition to that required to take care of the growth and maintenance requirements, are required for the production of an egg. Since the maintenance requirement of a chicken depends chiefly on its live weight, it follows that of two birds of the same live weight the one that lays the more eggs will require the more feed. Because chickens of the lighter breeds require less feed for maintenance than those of the heavier breeds, the former are more efficient in their utilization of feed for egg production, if both lay at the same rate.

USE OF FEED FOR FATTENING

Often chickens are fed special diets for a short time before they are to be killed and marketed. This special feeding is sometimes referred to as "fattening" but "finishing" is a more correct term. Chickens do not fatten readily while they are still growing rapidly; however, after they are fully grown, or nearly grown, they may be fattened—in the true sense of the word—if they are in good health and are fed properly.

The fattening of chickens ordinarily is not an economical process, because a rather large quantity of feed is required to produce a pound

of fat. On the other hand, the finishing of chickens for market is often profitable, because the quality and market value of the carcass are usually improved and fairly large gains in live weight may be made, even though no appreciable fattening takes place. In the younger birds the gain in live weight is due almost entirely to growth, but in the older birds it is due in part to the deposition of fat.

During the finishing process broilers that have an initial live weight of 1½ to 2 pounds require only 3¼ to 4¼ pounds of feed for each pound of gain, if they are of one of the heavy breeds; but if they are of one of the light breeds, they may require 4½ to 5½ pounds of feed. During the finishing or fattening process, roasters that weigh 4 to 5 pounds at the beginning require 4½ to 7 pounds of feed for each pound gain, and capons and fowls, which are generally heavier than roasters, require 8 to 12 pounds of feed per pound of gain. In the case of the last three classes of market chickens, the finishing process would not be economical, because of the relatively large quantities of feed required, if it were not for the fact that there is usually an improvement in the market quality of the final product which results in an increase in the price received per pound.

GENERAL PRINCIPLES OF FEEDING CHICKENS

Often the question is asked, "What are the best diets for growing chicks and laying stock?" The answer is that there are no best diets. Some diets, of course, are better than others, but a large number of good diets may be formulated. Any combination of suitable feedstuffs that will supply adequate quantities of all the necessary nutrients will make a good diet and give satisfactory results.

Inasmuch as growing chicks make more economical gains when they are permitted to eat all they want, and high egg production cannot be maintained for a long time if the feed supply is restricted, it has become a fairly common practice to keep feed before both growing chicks and laying stock all the time. Some poultrymen, however, believe that they are able to get the best results by feeding according to a definite daily schedule. When feed is not kept before the chickens all the time, but is fed according to a fixed schedule, it is a good practice to follow the schedule closely. This statement applies particularly to the feeding of laying stock.

NUTRITIVE REQUIREMENTS OF CHICKENS

The chicken requires for growth and reproduction essentially the same nutrients as are required by other animals. The diet must supply adequate quantities of carbohydrates, fat, protein, minerals, and vitamins. If the feeding is to be economical, too much of the more expensive nutrients—vitamins, proteins, and fats—should not be included in the diet.

CARBOHYDRATES AND FATS

The chief sources of energy utilized by animals for carrying on the vital processes are the carbohydrates and fats. If there is not a sufficient quantity of these two nutrients in the diet, an animal may utilize some of the protein in its feed as a source of energy; but

protein is not an economical source of energy. Fortunately, however, practical diets for chickens always contain enough carbohydrates and fats for meeting all the energy requirements as well as for supplying the fat that is required for other purposes.

Most of the grains and their byproducts are relatively rich in carbohydrates and contain some fats. Of the feedstuffs commonly used in the feeding of chickens, the only ones that do not contain a considerable quantity of carbohydrates are meat scrap, meat-and-bone scrap, fish meal, bonemeal, oystershell, limestone, and the fish and fish-liver oils that are used as sources of vitamins A and D. Nearly all the feedstuffs that are used contain at least some fats.

PROTEIN

Protein is a constituent of all the tissues of the animal body. Without it, growth and egg production are impossible. Protein comprises approximately 20 percent of the entire body of a chicken and nearly 14 percent of the contents of an egg.

Two broad classes of protein are recognized in the practical feeding of animals, namely, those in plant and animal materials. These two classes are referred to as plant protein and animal protein. In general, protein of animal origin is utilized better for growth and egg production by the chicken than is protein of plant origin. Although the grains and their byproducts contain some protein, it is necessary to supply additional protein to get good growth and egg production. In order that the protein in the diet may be utilized efficiently, it is desirable that 20 to 40 percent of the protein be derived from animal sources.

According to experiments conducted at the Beltsville Research Center, Beltsville, Md., the best proportion of protein in the diet of young growing chicks is about 21 percent. However, in the practical feeding of chickens it is usually more economical to reduce the percentage of protein as the chicks become older. A good practice is to feed a diet that contains 20 to 21 percent of protein until the chickens are about 12 weeks old and then to decrease gradually the protein content to about 16 to 17 percent by the time the pullets are ready to lay. The pullets may then be placed on a diet that has the same protein content but which is more suitable for the production of eggs.

MINERALS AND GRIT

The entire carcass of a chicken contains very nearly 4 percent of inorganic elements, or minerals, as they are commonly called; and the entire egg contains approximately 10 percent. For normal nutrition the chicken requires feeds containing sodium, potassium, calcium, magnesium, sulfur, phosphorus, chlorine, iodine, iron, manganese, copper, zinc, silicon, and possibly cobalt. Some of these elements, such as iodine, iron, copper, manganese, zinc, and silicon, are required in only small quantities, whereas chickens need more of others, such as calcium and phosphorus. In laying chickens the calcium requirement is very large, and if there is a marked deficiency of this element egg production is not possible.

All the common feedstuffs contain some minerals, but usually it is necessary to supply additional quantities of calcium, sodium, and chlorine, and at times it is necessary to supply some phosphorus and manganese. Calcium is supplied most satisfactorily in the form of oystershell or high-calcium limestone, sodium and chlorine in the form of common salt, phosphorus as steamed bonemeal, and manganese as manganous sulfate.

The phosphorus content of diets for growing chickens may vary from about 0.7 to 1 percent, or even more. The calcium content should be such that the ratio of calcium to phosphorus is about 1.6 to 1, but good results will ordinarily be obtained with any ratio between about 1.3 to 1, and 2 to 1. Laying chickens require considerably more calcium than do growing chickens. The proper quantity to include in their diet depends largely on the number of eggs produced and the phosphorus content of the diet. Good results will be obtained with laying stock if the diet contains about 1 percent of phosphorus and 2.4 percent of calcium. If laying chickens are fed both mash and grain, the mash should contain about 1.2 percent of phosphorus and 2.4 percent of calcium. If laying chickens are fed phosphorus and calcium are fed, it is both unnecessary and undesirable to let the chickens have access to oystershell or other calcium-bearing grit.

It is desirable to add a small quantity of salt to the diet of all classes of chickens. The quantity depends on the other ingredients of the diet but, ordinarily, 0.5 percent will be enough to add to all-mash diets and 1 percent to mashes with which grain is to be fed. Since there is always a possibility that the diet may be deficient in manganese, it is a good practice to add a small quantity. The manganese is easily added with the salt by using a mixture of 100 pounds of salt and 1.7 pounds of anhydrous manganous sulfate (or 2.5 pounds of manganous sulfate tetrahydrate).

If the diet contains very little or no meat scrap, meat-and-bone scrap, or fish meal, it is desirable to add a little phosphorus. This is best done by adding a small quantity of steamed bonemeal. The proper quantity to add can be stated only when the total phosphorus content of the other ingredients of the diet is known.

Chickens on range ordinarily get all the grit they need, but if they are kept in confinement without access to the soil, it is advisable to supply them with grit. The best materials to use as grit are native pebbles and river gravel, but when these are not readily available any hard, nonfriable rock material may be used. If an attempt is being made to control the quantity of calcium consumed by the chickens, neither oystershell nor limestone should be used as grit.

VITAMINS

The importance of vitamins in the proper nutrition of chickens is now generally recognized. Only very small quantities are required, but they are absolutely essential for the maintenance of health, growth, and reproduction. The following vitamins or vitamin-like factors are required for the normal nutrition of chickens: A, B_1, B_6, D, E, G (riboflavin), K, choline, pantothenic acid (chick antidermatosis factor), and the anti-gizzard-erosion factor. Almost any diet for chickens is likely to be deficient in vitamin D if it does not

contain a special source of this factor; and hence, when chickens do not have access to sunshine (fig. 1), a dependable source of vitamin D should be included in the diet. In practical feed mixtures for chickens there is also the possibility of a deficiency of vitamins A and G, but ordinarily there is no great likelihood of a deficiency of the other vitamins except D.

Vitamin A is necessary for growth, reproduction, and hatchability. It is of value in preventing infections of the eyes and respiratory tract. The richest sources of vitamin A are certain fish oils and fish-liver oils. Many green feedstuffs, such as fresh alfalfa, alfalfa-leaf meal, alfalfa meal, kale, clover, carrots, and most green grasses, are very good sources. Yellow corn, corn-gluten meal, field peas, and garden peas are fairly good sources. The grain sorghums and the cereal grains, except yellow corn, are not good sources. If chickens have access to plenty of good green range, it is not necessary to give a great deal of attention to the vitamin A content of the diet; but

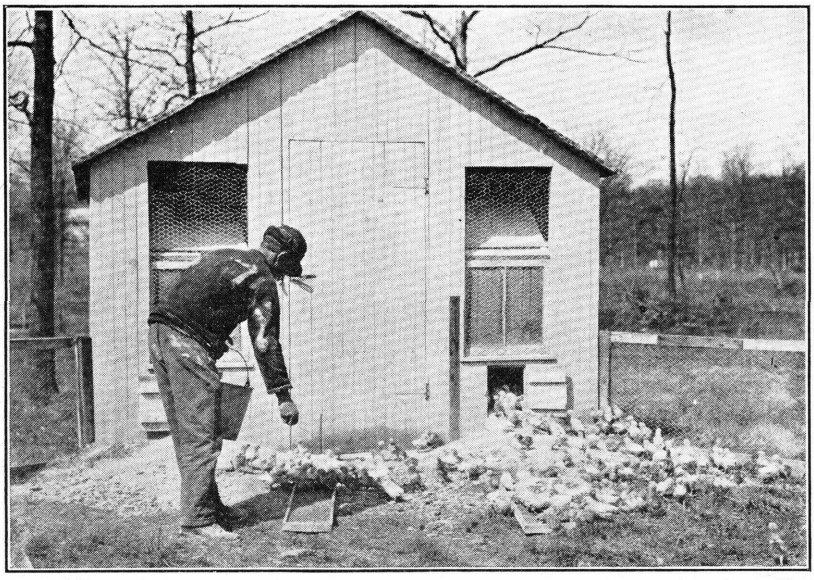

FIGURE 1.—If the chicks are given access to plenty of sunshine, their feed need not contain so much vitamin D as otherwise.

if the chickens are confined, care should be taken to supply enough of this important factor in the feed.

Vitamin B_1 is necessary for growth, the maintenance of appetite, and a normal condition of the intestinal tract, and for the prevention of a nerve disease known as polyneuritis. Seeds, cereal grains and their byproducts, green feed, and the several press-cake meals are all good sources of vitamin B_1, and, for this reason, practical diets for chickens are very rarely, if ever, deficient in this vitamin.

Vitamin B_6 is required for normal growth and the prevention of a nervous disorder in chickens. In general, feedstuffs that are sources of vitamin B_1 are also sources of vitamin B_6. Among the good sources of vitamin B_6 are yeast, liver, kidney, rice polishings, rice bran, wheat

germ, and molasses. The cereal grains and their byproducts are all fairly good sources. Practical diets are not likely to be deficient in this vitamin.

Vitamin D is sometimes called the antirachitic vitamin because it is an important factor in the prevention and cure of the bone disease known as rickets. This vitamin is necessary for bone growth, egg production, and hatchability. Too much vitamin D, however, decreases egg production and hatchability. This vitamin is unique in that it may be produced in the skin of animals through the action of sunshine or ultraviolet rays from special lamps. However, sunshine which passes through ordinary window glass is of no value as a source of vitamin D. This vitamin is not widely distributed in feedstuffs, and so it must be added to the diet when the chickens do not receive an abundance of sunshine. The best sources of this important vitamin are cod-liver oil, sardine oil, some other fish oils, activated 7-dehydro-cholesterol or products containing this substance, and cod-liver oils or sardine oils that have been fortified with vitamin A and D preparations [1] so that they contain 400 A. O. A. C. units of vitamin D and 3,000 U. S. P. units of vitamin A per gram.

Vitamin E is essential for reproduction. If special diets, in which the vitamin E has been destroyed or inactivated, are fed, very few if any of the resulting eggs will hatch. However, vitamin E is fairly widely distributed in natural feedstuffs, and there is very little likelihood that practical diets will be deficient in this factor.

Vitamin G, or riboflavin, is necessary for growth and hatchability. The richest sources are liver and other glandular tissues, yeast, dried whey, dried skim milk, and dried buttermilk. Fresh green feeds, such as alfalfa and grass, are usually good sources. Alfalfa products, when properly harvested and prepared, are good practical sources. Fish meals, meat scrap, and wheat germ are fair sources, but the cereal grains contain comparatively little.

Vitamin K is known as the antihemorrhagic vitamin. It has been found in a wide variety of materials such as hog-liver fat, hempseed meal, tomatoes, kale, and dried alfalfa. A deficiency of this vitamin increases the clotting time of the blood and causes hemorrhages to occur in the various tissues. There is no evidence, as yet, that ordinary diets are likely to be deficient in this factor.

Choline has been found to play a joint role with manganese in the prevention of perosis. Most feedstuffs contain some of this vitamin-like factor, and soybean meal is reputed to be an unusually good source. Practical diets are not likely to be seriously deficient in choline.

Pantothenic acid, formerly called the chick antidermatosis factor and sometimes referred to as the filtrate factor, is present in grain, grain products, and various other feedstuffs. Three of the richest sources are dried yeast, liver meal, and sugarcane molasses. Other good sources are peanut meal, dried whey, dried buttermilk, dehydrated alfalfa-leaf meal, dried skim milk, alfalfa meal, wheat bran, rice bran, and soybean meal. Most diets for chickens are likely to contain enough of this factor.

[1] Vitamin D in official units of the Association of Official Agricultural Chemists, and vitamin A in units set up by the United States Pharmacopoeia.

The anti-gizzard-erosion factor, as its name indicates, is a vitamin or vitaminlike factor that is necessary for the formation and maintenance of a normal gizzard lining. Its presence has been demonstrated in wheat bran, alfalfa products, lung tissue, pork liver and kidney, bile, kale, wheat middlings, and oats. There is evidence that there may be more than one anti-gizzard-erosion factor or that a deficiency of more than one factor may cause erosion of the gizzard.

WATER

Water is such a commonplace material that its importance is sometimes overlooked. It is, however, an essential constituent of eggs and animal tissues. Except when the grain-milk system of feeding or one of its modifications is used, a plentiful supply of fresh, clean water should be available and readily accessible to the chickens at all times.

EFFECT OF FEED ON FLESH AND EGGS

The feed consumed by chickens may affect the flavor and market value of both the flesh and the eggs. At times the flesh of chickens may have an undesirable flavor described as fishy. Such a flavor has been found even when the chickens have consumed diets which did not contain either fish meal or fish oil, nevertheless a fishy flavor when encountered often may be traced to the presence of fish products in the diet. For this reason, it is best to use only those fish meals which previously have been found not to cause a fishy flavor.

Some undesirable flavors found in the cooked flesh of chickens may be traced to the fact that the chickens were killed while there was still feed in their crops. To eliminate so far as possible the possibility of the flesh having an undesirable flavor, fishy or otherwise, three precautions should be taken: (1) Eliminate all fish products at least 2 weeks before the chickens are to be killed, (2) do not feed diets that contain rancid feedstuffs, and (3) withhold all feed from the chickens 12 to 16 hours before killing them.

The color of the skin and flesh of chickens is primarily a breed characteristic, but it may be affected to some extent by the feed. If large quantities of yellow corn, corn-gluten meal, or alfalfa products are fed, there is a tendency for the skin and some of the fat immediately under the skin to become yellow. On some markets a preference is shown for chickens with yellow skin, but when it is desired to have the skin of the chicken as light in color as possible, yellow corn and green feed should be fed sparingly.

In general, the color of the yolks of eggs may be controlled easily by feeding. If very light-colored yolks are desired, keep the chickens confined in the laying house or in bare yards and feed a diet that contains little or no yellow corn and but little alfalfa or alfalfa-leaf meal. The richer shades of yellow may be obtained by feeding diets in which the chief cereal grain is yellow corn and in which there is 5 to 10 percent of alfalfa products. Deep orange-red yolks may be obtained by feeding 0.5 to 2 percent of ground pimiento pepper or chili pepper. Cull peppers should be used because of their relative cheapness. An excessive intake of fresh green feed or green growing grass tends to cause a green-yellow or red-yellow color.

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Cottonseed meal should not be used in feeding laying stock, if the eggs are to be marketed. This product tends to cause the yolks to have a mottled appearance and to acquire an undesirable dark color when the eggs are kept in cold storage for a few months. Some weeds of the same botanical family as the cotton plant, such as the common mallow, have a similar effect on yolk color and at times may cause the whites of the eggs to have a pink tint.

The vitamin content of eggs may be affected by both diet and management. The content of the vitamins A, B, G, and D can be increased by feeding diets that contain relatively large quantities of these vitamins. The vitamin D content of the eggs of chickens on range is usually greater than that of the eggs produced by

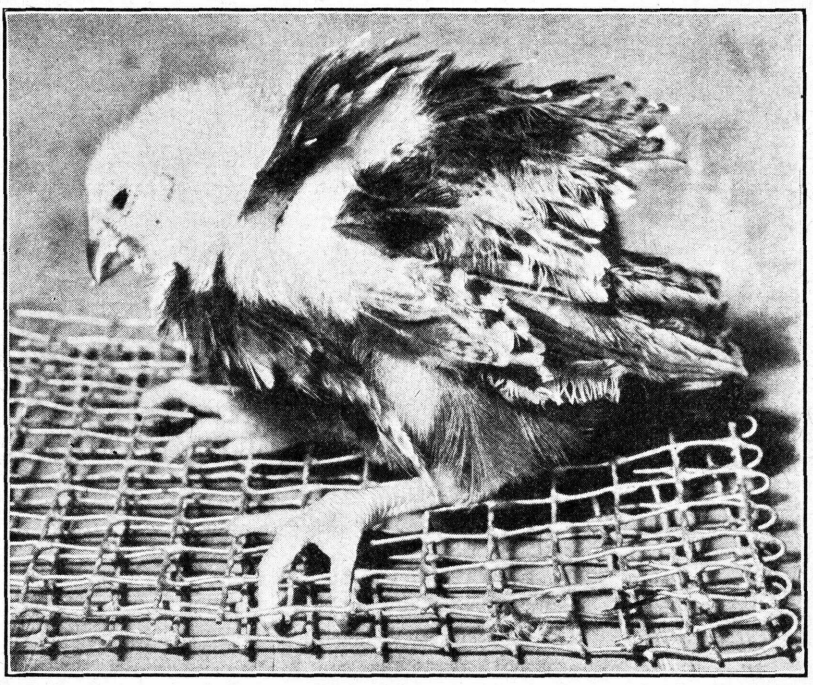

FIGURE 2.—A case of rickets. Note the crossed beak and the inability of the chick to stand. This condition does not develop if chicks get enough vitamin D, either from sunshine or from their diet.

chickens kept in confinement and fed the same diet. In general, the vitamin D content of the eggs of chickens on range tends to increase from March to June, but it may decrease during the warmer months of the year. This decrease during hot weather is caused by the tendency of the chickens to seek shade and thus to receive less sunshine.

DEFICIENCY DISEASES AND VICES

Several diseases and vices of chickens are caused by feeding diets that are deficient in one or more essential nutritive factors. Nutritional roup, rickets (fig. 2), "curled toe paralysis," chick dermatosis, "crazy chick" disease (nutritional encephalomalacia), gizzard erosion,

and perosis are all the result of nutritional deficiencies. The first is caused by diets that contain too little vitamin A; the second by diets that contain too little vitamin D, too little calcium or phosphorus, or an improper balance of calcium and phosphorus. "Curled-toe paralysis" is caused by feeding diets that are deficient in vitamin G. A deficiency of pantothenic acid (chick antidermatosis factor) is the cause of chick dermatosis.

Crazy chick disease is probably caused by a deficiency of vitamin E in the diet. In any case it is possible to stop the development of this disease and to cure many of the affected chickens by giving them synthetic vitamin E or by including 1 to 2 percent of corn oil, peanut oil, soybean oil, or cottonseed oil in their diet.

The exact nature of the deficiency or deficiencies that cause gizzard erosion is not known. However, it has been found that certain combinations of feedstuffs are more effective than others in curing this

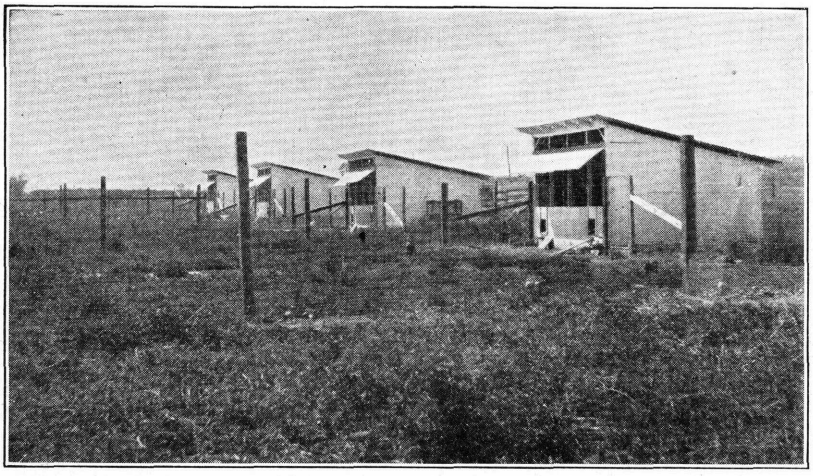

FIGURE 3.—When plenty of good range is provided, the possibility of the chickens suffering from nutritional deficiencies is greatly reduced.

condition in chicks. A few of the feedstuffs that seem to be of definite value in curing gizzard erosion are alfalfa-leaf meal, oats, and bran. Fortunately, gizzard erosion appears to have no marked effect on growth or viability.

Perosis (slipped tendon, or hock disease) is caused by a deficiency of either manganese or choline, or both, in the diet of growing chicks. Under practical conditions it usually can be prevented merely by adding a very small quantity of manganous sulfate to the diet, because a deficiency of choline occurs more rarely than a deficiency of manganese. If the diet of laying chickens is deficient in manganese, the embryos develop abnormally, and hatchability is decreased.

Feather picking, cannibalism, and egg eating are believed by some research workers in poultry nutrition to be caused by unsatisfactory diets. In confirmation of this belief it has been observed that the first two of these vices are less likely to occur if the diet contains 10 to 20 percent of oats or 20 to 30 percent of bran. Management is

also an important factor in the development of feather picking, cannibalism, and egg eating, as is shown by the fact that these vices are more likely to occur when the chickens are crowded than when they have plenty of space. There are, apparently, a number of causes of egg eating, but the tendency to acquire this vice is greatly increased by a deficiency of either calcium or vitamin D in the diet.

Experiments have shown that feather picking and cannibalism often can be stopped very quickly and easily by increasing the salt content of the diet for 2 or 3 days. If an all-mash diet is being fed, 2 percent of salt is added; but if both mash and grain are being fed, 4 percent of salt is added to the mash. Usually the desired effect is obtained within a few hours after the salt is added to the diet, but in some cases it may be necessary to feed the extra salt for 2 or 3 days. This salt treatment is recommended for the cure but not for the prevention of feather picking and cannibalism. In other words, it is not recommended that typical all-mash diets contain more than 0.5 to 0.7 percent of added salt or that mashes with which grain or a grain mixture is to be fed contain more than 1 to 1.2 percent of added salt.

If the salt treatment does not stop the feather picking or cannibalism within 3 days, it may be necessary to trim back to the quick the upper mandible of the beak of each chicken. This may be done with a sharp knife or a hot soldering iron. The trimming of the beak is painless, if it is done properly. Ordinarily, only about three-sixteenth of an inch of the tip of the beak is removed; the proper amount can be judged readily by the appearance of the beak substance.

The use of ruby lights and window panes stained a ruby color has been reported to be effective in a number of instances in preventing, or at least curbing, both feather picking and cannibalism in chickens of all ages. In the case of adult chickens, especially when on range, various mechanical devices that are attached to the beak have been used, and some of them are reported to be quite efficacious in preventing the chickens picking each other.

SELECTING FEEDSTUFFS

Careful attention should be given to the selection of feedstuffs that are to be used in compounding diets for chickens. Only good, clean, wholesome materials should be used. Musty and rancid feedstuffs should be carefully avoided.

In general the cereal grains, and sometimes the grain sorghums, are used as the chief sources of energy. Flour-mill byproducts, such as bran and middlings, are of value because they supply bulk and their use tends to produce a loose-textured feed; furthermore, they are good sources of several of the vitamins and vitaminlike factors. Dried skim milk, dried buttermilk, fish meal, meat scrap, and meat-and-bone scrap are the most commonly used sources of animal protein; liquid skim milk is sometimes used, but it contains only about 3.5 percent of protein. Soybean meal, peanut meal, cottonseed meal, linseed meal, and corn-gluten meal are the concentrated sources of vegetable protein that are most frequently used. Alfalfa-leaf meal and alfalfa meal are usually good sources of vitamins A and G. The most commonly used mineral supplements are oystershell.

ground limestone, steamed bonemeal, and salt. The best sources of vitamin D are the fish-liver oils and other fish oils; but, of course, the cheapest source of vitamin D is sunshine.

Linseed meal, when used in small quantities, not more than 2 or 3 percent of the total feed intake, is of value because it absorbs a fairly large quantity of water and thus produces a somewhat bulky, mucilaginous mass that aids in the passage of food residues through the intestines.

Green feeds have been highly prized and widely used by poultry keepers. They are generally good sources of vitamins A, B, E, and G and of protein of good quality. Modern research in poultry nutrition, however, has clearly shown that green feeds are not necessary if the vitamins that they contain are supplied in other ways. When good clean range is available as a source of fresh green feed it should be utilized to the fullest extent possible. However, it generally is not economical to use fresh green feed that must be cut and taken to the chickens.

Cod-liver oil, alfalfa-leaf meal, alfalfa meal, and yellow corn may be used to supply the vitamin A; and dried skim milk, dried buttermilk, dried whey, and alfalfa products to supply the vitamin G. Vitamins B and E, as previously indicated, are supplied by seeds, grains, alfalfa products, middlings, and shorts.

If too much milk, bran, limestone, steamed bonemeal, or salt is included in the diet, there is a tendency for the droppings to be loose, and as a result a large percentage of the eggs may become soiled and therefore have a decreased market value. The addition of 2 or 3 percent of linseed meal to the diet will frequently cause the droppings to be more firm; but when this does not produce the desired result, a reduction in the quantity of salt, steamed bonemeal, or bran may be necessary.

PRACTICAL POINTS IN FEEDING CHICKENS

Various methods and feed mixtures are used in feeding chickens, but if suitable feedstuffs, which are wholesome and palatable and supply adequate quantities of all the nutrients, are used good results are likely to be obtained. The two most common methods are the all-mash method and the mash-grain method. The names of these methods are self-explanatory. In the pages that follow, formulas are given for all-mash diets, for mashes that are to be fed with grain or a grain mixture, and for grain mixtures.

MIXING THE MASH

All the ingredients of a mash should be thoroughly mixed to insure a uniform distribution of those that are present in relatively small quantities. It is best to weigh out first the more bulky ingredients and those that are used in greatest quantity, and then to add the other ingredients. It is a desirable practice to mix the salt and the other mineral supplements with some of the bran or middlings before adding them to the other ingredients. All oils should be mixed thoroughly with a suitable portion of the bran or ground corn before they are added. If pulverized or very finely ground oats is an ingredient, it is preferable to mix the oil with a portion, because finely ground oats tend to prevent destruction of the vitamin A in the oil.

When it is not convenient for the poultryman to keep supplies of all the feedstuffs required to make a good mash, he may use a ready-mixed mash, or he may take his formula to a local miller or feed dealer and have the mash mixed. Commercial mixed feeds are now widely used, and many of them are of excellent quality. If a ready-mixed mash is used, the method of feeding should be that recommended by the manufacturer.

FEEDING GROWING CHICKS

Baby chicks usually are fed for the first time when they are 1 or 2 days old. Feed may be withheld for as long as 3 days, but the best results are obtained if both feed and water are supplied when the chicks are between 24 and 36 hours old.

Regardless of what method of feeding is used finally, the most common practice is to start with an all-mash diet. If the all-mash method is to be continued, the chicks are either started on an all-mash starting and growing diet and kept on it until the all-mash laying diet is fed for the first time, or they are started on an all-mash starting diet and then placed on an all-mash growing diet when they are 6 to 8

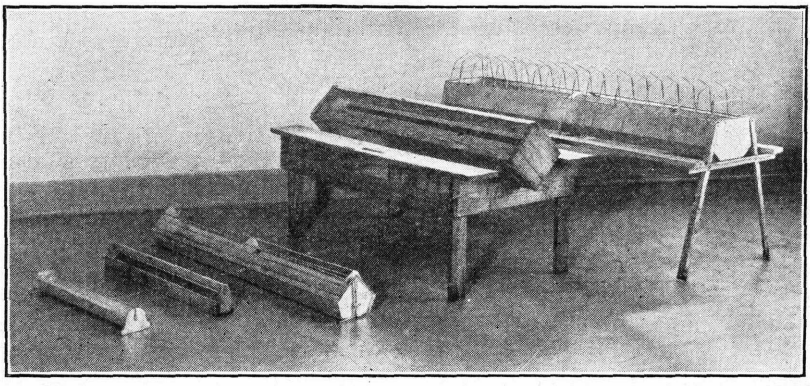

FIGURE 4.—Home-made (wood) and ready-made (metal) feed hoppers of various sizes.

weeks old and kept on this diet until they are ready to be placed on the all-mash laying diet. If the mash-grain method is to be used, the chicks may be started on either a starting and growing mash or a starting mash, but if the chicks are started on the latter mash they usually are placed on a growing mash when they are 8 to 12 weeks old. In either case the feeding of finely cracked grain is begun at the age of about 4 weeks. After the chicks are 6 to 8 weeks old, grain that is more coarsely cracked may be used; and after the chicks are 10 to 12 weeks old whole grain may be fed. Some poultrymen prefer to feed only mash until the chicks are 8 to 12 weeks old.

It is best to start changing from diets that are suitable for growing chicks to diets that are suitable for laying chickens about 1 month before egg production is expected to begin. It is preferable that the change be not abrupt. If possible, allow 2 weeks for making the change. During the first 2 days replace one-eighth of the all-mash starting and growing diet—or all-mash growing diet—with an equal

weight of all-mash laying diet, or replace one-eighth of the starting and growing mash—or growing mash—with an equal weight of laying mash. During the next 2 days replace two-eighths of the feed that is being fed with an equal weight of that which is to be fed, and continue every 2 days to increase by an eighth the quantity of feed that is replaced until the replacement is complete. In this way the change from one feed to another will require 2 weeks, and the pullets will be receiving feed suitable for laying stock for about 2 weeks efore egg production begins.

Inasmuch as some of the chicks may not learn to eat so quickly as the others, it is a good practice to train the chicks to eat during the first day feed is placed before them. This is done easily by taking the chicks from under the hover every hour or so and placing them on boards on which feed hoppers of suitable size have been placed. To get the chicks to begin eating promptly it may be necessary to scatter a small quantity of feed around the feed hoppers. If the chicks are being started in battery brooders, it will be a simple matter to make them leave the hover, or heated portion, and go out to the feed troughs. After the chicks have learned to eat, it is a good practice to keep feed and water before them all the time. As the chicks increase in size, larger feed hoppers (fig. 4) and water containers should be used.

Plenty of feeding and drinking space is essential. At first 2 inches of feeding space and ½-inch of drinking space per chick should be provided. As the chicks grow older both feeding and drinking space must be increased. Careful observation of the chickens at the feed hoppers and water containers is the best guide to follow in providing such space. If throughout the day the chickens are crowded around the feed hoppers or water containers, more feeding or drinking space should be provided.

During the hot summer months it is sometimes difficult to get growing chickens on range to eat enough feed for good growth. For this reason it is desirable to provide plenty of natural or artificial shade and to keep both feed and water in each such place.

If the all-mash method of feeding is to be used, the following diets will be found to be entirely satisfactory, no matter whether the chicks are being raised in brooder houses with access to range or in battery brooders:

ALL-MASH STARTING AND GROWING DIET NO. 1

Ingredient	*Parts, by weight*
Ground yellow corn	32.0
Wheat middlings	20.0
Wheat bran	15.0
Dried skim milk (or dried buttermilk)	5.0
Meat scrap	5.0
Fish meal	5.0
Soybean meal	5.0
Corn-gluten meal	5.0
Alfalfa-leaf meal	5.5
Ground limestone (or oyster-shell)	1.5
Common salt (or salt mixture)	.5
Cod-liver oil [1, 2]	.5
Total	100.0

ALL-MASH STARTING AND GROWING DIET NO. 2

Ingredient	*Parts, by weight*
Ground yellow corn	30.0
Finely ground oats	10.0
Wheat middlings	10.0
Wheat bran	10.0
Dried skim milk (or dried buttermilk)	10.0
Meat scrap	10.0
Soybean meal	10.0
Alfalfa-leaf meal	8.0
Ground limestone (or oyster-shell)	1.0
Salt mixture	.5
Cod-liver oil [1, 2]	.5
Total	100.0

ALL-MASH STARTING AND GROWING DIET NO. 3

Ingredient	Parts, by weight
Ground yellow corn	33.0
Wheat middlings	20.0
Wheat bran	15.0
Meat scrap	16.0
Dried skim milk (or dried buttermilk)	5.0
Alfalfa-leaf meal	9.0
Ground limestone (or oystershell)	1.0
Common salt (or salt mixture)	.5
Cod-liver oil [1, 2]	.5
Total	100.0

ALL-MASH STARTING AND GROWING DIET NO. 4

Ingredient	Parts, by weight
Ground yellow corn	37.0
Finely ground oats	10.0
Wheat middlings	10.0
Wheat bran	10.0
Meat scrap	17.0
Dried skim milk (or dried buttermilk)	5.0
Alfalfa-leaf meal	9.0
Ground limestone (or oystershell)	1.0
Salt mixture	.5
Cod-liver oil [1, 2]	.5
Total	100.0

[1] Or 0.12 part, by weight, of fortified cod-liver oil or fortified sardine oil that contains not less than 400 A. O. A. C. chick units of vitamin D per gram. If some other source of vitamin D is used, the quantity should be such that each pound of mixed feed will contain between 180 and 215 A. O. A. C. chick units of vitamin D.

[2] If the chicks have access to range and plenty of sunshine, the cod-liver oil or other source of vitamin D may be omitted after the eighth week.

The salt mixture listed in these four diets should consist of 100 pounds of common salt and 1.7 pounds of anhydrous manganous sulfate (or 2.5 pounds of manganous sulfate tetrahydrate). The use of this salt mixture is optional in diets Nos. 1 and 3 but is required in diets Nos. 2 and 4.

The cod-liver oil should contain not less than 85 A. O. A. C. chick units [2] of vitamin D and not less than 600 International Units of vitamin A per gram. If fortified cod-liver oil or other fish oil is used, the quantity recommended by the manufacturer should be included in the diet.

Any ground grain or mixture of ground grains may be used in place of ground yellow corn in these four all-mash diets. Meat scrap and fish meal may be used interchangeably. Peanut meal may be used in place of soybean meal in diets Nos. 1 and 2 and in place of corn gluten meal in diet No. 1. Oystershell and limestone grit should not be fed with these all-mash diets because all the needed calcium is included.

If the mash-grain method of feeding is used, the following starting and growing mashes will give good results:

STARTING AND GROWING MASH NO. 1

Ingredient	Parts, by weight
Ground yellow corn	17.5
Wheat middlings	30.0
Wheat bran	10.0
Dried skim milk (or dried buttermilk	10.0
Meat scrap	5.0
Fish meal	4.0
Soybean meal	4.0
Corn-gluten meal	4.0

STARTING AND GROWING MASH NO. 1—Continued.

Ingredient	Parts, by weight
Alfalfa-leaf meal	10.0
Ground limestone (or oystershell)	2.0
Steamed bonemeal	1.5
Salt mixture	1.0
Cod-liver oil [1, 2]	1.0
Total	100.0

[2] This is the official unit of the Association of Official Agricultural Chemists. It is equivalent to 1 International Unit of the kind of vitamin D that is in pure cod-liver oil.

STARTING AND GROWING MASH NO. 2

Ingredient	Parts, by weight
Ground yellow corn	19.0
Finely ground oats	12.0
Wheat middlings	12.0
Wheat bran	12.0
Dried skim milk (or dried buttermilk)	10.0
Meat scrap	10.0
Soybean meal	10.0
Alfalfa-leaf meal	10.0
Ground limestone (or oystershell)	1.0
Steamed bonemeal	2.0
Salt mixture	1.0
Cod-liver oil [1, 2]	1.0
Total	100.0

STARTING AND GROWING MASH NO. 3

Ingredient	Parts, by weight
Ground yellow corn	21.0
Wheat middlings	30.0
Wheat bran	10.0
Dried skim milk (or dried buttermilk)	10.0
Meat scrap	15.0
Alfalfa-leaf meal	10.0
Ground limestone (or oystershell)	2.0
Salt mixture	1.0
Cod-liver oil [1, 2]	1.0
Total	100.0

STARTING AND GROWING MASH NO. 4

Ingredient	Parts, by weight
Ground yellow corn	23.0
Finely ground oats	12.0
Wheat middlings	12.0
Wheat bran	12.0
Dried skim milk (or dried buttermilk)	10.0
Meat scrap	17.0
Alfalfa-leaf meal	10.0
Ground limestone (or oystershell)	2.0
Salt mixture	1.0
Cod-liver oil [1, 2]	1.0
Total	100.0

[1] Or 0.25 part, by weight, of fortified cod-liver oil or fortified sardine oil that contains not less than 400 A. O. A. C. chick units of vitamin D per gram. If some other source of vitamin D is used, the quantity should be such that each pound of mixed feed will contain between 360 and 430 A. O. A. C. chick units of vitamin D.

[2] If the chicks have access to range and plenty of sunshine, the cod-liver oil or other source of vitamin D may be omitted after the eighth week.

The composition of the salt mixture and the specifications for the cod-liver oil used in these four mashes are the same as those for the preceding all-mash diets.

The substitutions permitted in the preceding all-mash diets may also be made in these starting and growing mashes. As when the all-mash diets are used, oystershell or limestone grit should not be given to the chicks. After the feeding of grain or a grain mixture is begun, insoluble grit may be given to the chicks, but ordinarily this is not necessary if they have access to the soil.

Various grain mixtures may be used with these starting and growing mashes after the chicks are 4 weeks old, but some poultrymen prefer not to feed any grain until the chicks are 8 to 12 weeks old. If grain or a grain mixture is fed to chicks at the age of 4 weeks, it should be more finely cracked than when it is fed at an age of 8 to 12 weeks. If desired, cracked corn alone may be used; however, several grain mixtures are suggested for those who prefer to use them.

GRAIN MIXTURE NO. 1

Ingredient	Parts, by weight
Cracked corn	50
Cracked wheat	25
Steel-cut oats, or oat groats	25
Total	100

GRAIN MIXTURE NO. 2

Ingredient	Parts, by weight
Cracked corn	50
Wheat	50
Total	100

GRAIN MIXTURE NO. 3 [1]

Ingredient	Parts, by weight
Whole corn	50
Wheat	25
Oats or barley	25
Total	100

GRAIN MIXTURE NO. 4 [1]

Ingredient	Parts, by weight
Whole corn	75
Oats or barley	25
Total	100

GRAIN MIXTURE NO. 5 [1]

Ingredient	Parts, by weight
Whole corn	50
Wheat, oats, barley, milo, or kafir	50
Total	100

GRAIN MIXTURE NO. 6 [1]

Ingredient	Parts, by weight
Whole corn, milo, or kafir	25
Wheat	25
Oats or barley	25
Sunflower seed	25
Total	100

[1] It is best to delay feeding whole corn, oats, and barley until the chickens are about 10 to 12 weeks old.

Feeding grain or a grain mixture in the litter is an insanitary practice and is often responsible for the spread of disease. A better practice is to feed the grain in hoppers in the same way as the mash. Only a small quantity of grain, about one-tenth of the quantity of mash that is being consumed, should be fed at first. The quantity of grain should be increased gradually so that about equal parts of mash and grain are being fed by the time the chicks are 15 or 16 weeks old.

FEEDING LAYING AND BREEDING STOCK

The eggs of high-producing chickens tend to have a higher average hatchability than those of low producers. Moreover, to obtain eggs that hatch well it is necessary to feed a diet that contains somewhat more of most of the vitamins than is required merely to get good egg production. But in general it is best to feed diets that will permit the chickens to produce eggs of high hatchability. The all-mash diets for layers and the laying mashes are formulated for the maximum production of eggs that will have a high hatchability, even though the chickens are confined in laying batteries.

ALL-MASH LAYING DIET NO. 1

Ingredient	Parts, by weight
Ground corn	39.0
Wheat middlings	20.0
Wheat bran	15.0
Dried skim milk (or dried buttermilk)	5.0
Meat scrap	2.0
Fish meal	2.0
Soybean meal	2.0
Corn-gluten meal	2.0
Alfalfa-leaf meal	6.0
Ground limestone (or oyster-shell)	3.6
Steamed bonemeal	1.0
Common salt (or salt mixture)	1.0
Cod-liver oil [1, 2]	1.4
Total	100.0

ALL-MASH LAYING DIET NO. 2

Ingredient	Parts, by weight
Ground corn	40.0
Finely ground oats	10.0
Wheat middlings	10.0
Wheat bran	10.0
Dried skim milk (or dried buttermilk)	5.0
Meat scrap	4.0
Soybean meal	5.0
Linseed meal (old process)	2.0
Alfalfa-leaf meal	7.0
Ground limestone (or oyster-shell)	3.0
Steamed bonemeal	1.6
Common salt (or salt mixture)	1.0
Cod-liver oil [1, 2]	1.4
Total	100.0

ALL-MASH LAYING DIET NO. 3

Ingredient	Parts, by weight
Ground corn	40.0
Wheat middlings	20.0
Wheat bran	15.0
Dried skim milk (or dried buttermilk)	5.0
Meat scrap	6.5
Alfalfa-leaf meal	7.0
Ground limestone (or oystershell)	3.4
Steamed bonemeal	.7
Common salt (or salt mixture)	1.0
Cod-liver oil [1, 2]	1.4
Total	100.0

ALL-MASH LAYING DIET NO. 4

Ingredient	Parts, by weight
Ground corn	42.0
Finely ground oats	10.0
Wheat middlings	10.0
Wheat bran	10.0
Dried skim milk (or dried buttermilk)	5.0
Meat scrap	7.5
Linseed meal (old process)	2.0
Alfalfa-leaf meal	7.5
Ground limestone (or oystershell)	2.8
Steamed bonemeal	.8
Common salt (or salt mixture)	1.0
Cod-liver oil [1, 2]	1.4
Total	100.0

[1] Or about 0.3 part, by weight, of fortified cod-liver oil or fortified sardine oil that contains not less than 400 A. O. A. C. chick units of vitamin D per gram. If some other source of vitamin D is used, the quantity should be such that each pound of mixed feed will contain between 500 and 600 A. O. A. C. chick units of vitamin D.

[2] If the chickens have access to range and plenty of sunshine, one-half of the cod-liver oil may be omitted.

The composition of the salt mixture and the specifications for the cod-liver oil used in these four diets are the same as those for the all-mash starting and growing diets previously given. Also, the same substitutions may be made in these diets. Oystershell or limestone grit should not be given to the chickens because these diets contain all the calcium necessary for maximum egg production.

If the mash-grain method of feeding is preferred, the following laying mashes may be used:

LAYING MASH NO. 1

Ingredient	Parts, by weight
Wheat middlings	31.5
Wheat bran	20.0
Dried skim milk (or dried buttermilk)	10.0
Meat scrap	4.5
Fish meal	5.0
Soybean meal	2.3
Corn-gluten meal	2.4
Alfalfa-leaf meal	12.0
Ground limestone (or oystershell)	6.8
Steamed bonemeal	1.5
Common salt (or salt mixture)	1.2
Cod-liver oil [1, 2]	2.8
Total	100.0

LAYING MASH NO. 2

Ingredient	Parts, by weight
Finely ground oats	19.0
Wheat middlings	15.0
Wheat bran	10.0
Dried skim milk (or dried buttermilk)	10.0
Meat scrap	10.0
Soybean meal	5.0

LAYING MASH NO. 2—Continued.

Ingredient	Parts, by weight
Linseed meal	4.0
Alfalfa-leaf meal	15.0
Ground limestone (or oystershell)	5.6
Steamed bonemeal	2.4
Salt mixture	1.2
Cod-liver oil [1, 2]	2.8
Total	100.0

LAYING MASH NO. 3

Ingredient	Parts, by weight
Wheat middlings	32.0
Wheat bran	20.0
Dried skim milk (or dried buttermilk)	10.0
Meat scrap	14.0
Alfalfa-leaf meal	13.0
Ground limestone (or oystershell)	6.5
Steamed bonemeal	0.5
Common salt (or salt mixture)	1.2
Cod-liver oil [1, 2]	2.8
Total	100.0

LAYING MASH NO. 4

Ingredient	Parts, by weight
Finely ground oats	20.0
Wheat middlings	15.0
Wheat bran	10.0
Dried skim milk (or dried buttermilk)	10.0
Meat scrap	15.0
Linseed meal	4.0
Alfalfa-leaf meal	15.0
Ground limestone (or oystershell)	5.5
Steamed bonemeal	1.5
Salt mixture	1.2
Cod-liver oil [1, 2]	2.8
Total	100.0

LAYING MASH NO. 4—Continued.

[1] Or about 0.6 part, by weight, of fortified cod-liver oil or fortified sardine oil that contains not less than 400 A. O. A. C. chick units of vitamin D per gram. If some other source of vitamin D is used, the quantity should be such that each pound of mixed feed will contain between 1,000 and 1,100 A. O. A. C. chick units of vitamin D.

[2] If the chickens have access to range and plenty of sunshine, one-half of the cod-liver oil may be omitted.

The composition of the salt mixture and the specifications for the cod-liver oil used in these four laying mashes are identical with those for the all-mash starting and growing diets. In compounding these mashes fish meal and meat scrap may be used interchangeably and barley may be used in place of oats. Inasmuch as these mashes contain all the calcium that is required for maximum egg production, oystershell and limestone grit should not be given to the chickens. Insoluble grit may be supplied, if desired, but this ordinarily is not necessary when the birds have access to the soil.

Any one of the grain mixtures, on pages 16 and 17, may be fed with these laying mashes; however, corn is generally as satisfactory as a grain mixture that contains several ingredients, provided that the mash contains enough manganese. All mashes and diets given in this bulletin are formulated to contain an adequate supply of manganese.

It is a common practice to feed the grain or grain mixture once or twice daily; however, some poultrymen prefer to keep both grain and mash before the chickens all the time. When grain is fed twice daily, about one-third of the total quantity is generally fed during the morning and the remainder just before the birds go to roost. If the chickens do not eat enough mash to maintain good egg production, it is advisable to delay the morning feeding of grain until 10 or 11 o'clock. It is worth the extra time to keep a record of the quantities of mash and grain that are consumed and to attempt to feed approximately as much of the one as of the other. The four laying mashes are so formulated that ordinarily the best results will be obtained if just as much grain as mash is fed.

Clean litter should be kept on the floor and in the nests, because clean litter is a necessity for the production of clean eggs.

When a premium is paid for eggs that have light-colored yolks, white corn rather than yellow corn may be used in mixing the all-mash diets, as well as the grain mixtures that are to be fed with laying mashes. When white corn is not available, wheat and barley or wheat and oats may be used instead. If the yolks are still too deeply colored, soybean meal may be substituted weight for weight for the corn-gluten meal, and one-half of the alfalfa meal may be replaced by a mixture of 2 parts of dried whey and 1 part of oats or barley.

When a special effort is being made to obtain eggs of uniform yolk color, the all-mash and pellet methods of feeding are preferable. In the production of table eggs of high market value, it is desirable that the yolks of all the eggs have approximately the same color.

Adequate feeder space should be provided for each flock of laying hens (cover page). If there is not enough mash-hopper space the chickens may not be able to consume enough mash to maintain a high rate of egg production. One hopper 10 feet long which permits feeding from both sides, or equivalent feeding space, should be provided for each 100 hens. It is equally important to provide plenty of drinking space, and an adequate water supply, a 10- to 12-quart container for each 100 chickens. However, in the final analysis no rule-of-thumb method of furnishing enough eating and drinking space is as reliable as actual observation of the chickens. If the chickens are crowded around the feed hoppers or water containers during the greater part of the day, more feeding or drinking space should be provided.

FEEDING BREEDING MALES

It is a good practice to separate the cockerels from the pullets when they are 8 to 10 weeks old. However, both sexes may be fed the same diet until the pullets are placed in laying quarters. After the males are separated from the females, those that are to be kept for breeding should be continued on a good growing diet until they are placed in mating pens. However, if some of the males are not to be used for breeding until they are more than 9 months old, they may be placed at that age on the following simplified all-mash diet for segregated males:

ALL-MASH DIET FOR BREEDING MALES

Ingredient	*Parts, by weight*
Ground yellow corn	50.0
Wheat middlings	36.0
Dried skim milk (or dried buttermilk)	5.0
Alfalfa-leaf meal	5.0
Linseed meal (old process)	2.0
Ground limestone (or oystershell)	1.3
Common salt	.5
Cod-liver oil	.2
Total	100.0

FINISHING CHICKENS FOR MARKET

Whether or not the poultry keeper should finish his chickens for market depends on the particular circumstances. If the chickens are in good condition as a result of having been raised on well-balanced diets, nothing is to be gained by feeding a special feed mixture to prepare them for market. On the other hand, considerable weight may be gained by healthy chickens that are not in good flesh, if they are liberally fed a suitable feed mixture. Ordinarily, however, it is doubtful that the poultry keeper should attempt to finish or fatten his chickens before he markets them; and therefore it is generally best for him to sell them directly from the range or growing batteries. The finishing of chickens for market is done most economically on a large scale at feeding stations that are especially equipped for that purpose. Inasmuch, however, as there may be times when the poultryman will find it profitable to finish his chickens for market, the following information on diets and methods is given:

In finishing broilers for market it should be remembered that they are still growing and that they require somewhat more protetin in their feed than is required by roasters, capons, and fowls. The best results are obtained if the chickens are placed in small pens or in

fattening batteries and are fed a suitable wet mash two or three times a day. The first few feedings should be relatively light, but beginning with the last feeding on the second day the chickens may be given all the wet mash they can consume in half an hour.

When plenty of liquid skim milk or buttermilk is available, good results will be obtained by using a mixture of equal parts of ground corn and finely ground oats to which enough of the milk has been added to make a wet mash that pours readily. The addition of 1.5 to 2 percent of ground limestone to the mixture of ground corn and oats will aid in reducing the number of cases of broken wings when the chickens are being killed and dressed.

If neither skim milk nor buttermilk is available in liquid form, a mixture of 9 parts of water and 1 part of either dried skim milk or dried buttermilk may be used instead. When oats cannot be had at a reasonable price, wheat middlings or shorts may be substituted for them.

If so-called white-fleshed birds—that is, those with little or no yellow color in their skin—are desired, white corn instead of yellow corn may be used in compounding the finishing diets.

Broilers may be fed the special finishing diets for as long a period as 2 weeks, but usually it is not worth while to finish roasters, capons, and fowls for more than a week.

If the finishing of chickens for market is being done on a large scale, the following diets will be found to be somewhat more satisfactory than the simple mixtures of corn, oats, and milk or of corn, middlings or shorts, and milk:

FINISHING DIET FOR BROILERS [1]

Ingredient	*Parts, by weight*
Ground corn	38.5
Finely ground oats	32.0
Meat scrap	13.0
Dried buttermilk	7.0
Alfalfa-leaf meal	5.0
Corn oil	2.4
Ground limestone	1.6
Common salt	.5
Total	100.0

FINISHING DIET FOR ROASTERS, CAPONS, AND FOWLS [1]

Ingredient	*Parts, by weight*
Ground corn	44.0
Finely ground oats	34.0
Dried buttermilk	10.0
Meat scrap	6.0
Corn oil	3.8
Ground limestone	1.7
Common salt	.5
Total	100.0

[1] Enough water to give the desired consistency for feeding, ordinarily, just enough so that the mixture will pour readily, should be added.

USE OF MILK AND HOME-GROWN GRAIN

Many farmers have an abundance of liquid skim milk, buttermilk, or both, which they can use advantageously in feeding chickens. Likewise, some flock owners may find it more profitable to feed home-grown grain than to sell the grain and buy all their feed ready-mixed. When there is sufficient milk available and the grain-milk system of feeding is used, the chickens are usually given nothing but liquid skim milk or buttermilk to drink and are permitted to eat all the grain or grain mixture they want. Oystershell or limestone grit is fed in hoppers.

The grain-milk system may be used in feeding both growing and laying chickens, but in the case of the former an all-mash starting diet should be fed for the first 10 weeks, and the feeding of cracked grain should be begun after the fourth week. The quantity that is fed should be increased as rapidly as possible. The starting mash should

not be discontinued abruptly but decreased gradually between the fourth and tenth weeks, so that none is being fed by the end of the tenth week. After the eighth or tenth week, depending on how well the chicks have grown, the feeding of cracked grain may be discontinued gradually and the feeding of whole grain begun.

When the grain-milk system is used in the feeding of laying stock, between 4 and 5 gallons of milk should be available each day for each 100 chickens. Water should not be given to the chickens until this quantity of milk has been consumed.

If only a limited quantity of milk is available, the grain-milk system is not so satisfactory. However, milk may be fed with any of the all-mash diets or any of the mashes given in this bulletin and the cost reduced by leaving out a part or all of the dried milk. For each part of dried milk omitted from 100 parts of a feed mixture, 1.5 gallons of liquid milk should be supplied with each 100 pounds of feed mixture consumed. Thus, if all-mash starting and growing diet No. 1 is being fed at the rate of about 20 pounds per day, all the dried milk (5 parts) may be omitted from the formula, if 1.5 gallons of milk is available each day. Or, if laying mash No. 1 is being fed at the rate of 100 pounds per day, all the dried milk (10 parts) may be omitted from the formula, if 15 gallons of milk is available each day; if only 7.5 gallons is available, only one-half (5 parts) of the dried milk should be omitted.

As valuable as liquid milk is in the feeding of poultry its use has several drawbacks. During the warmer months it attracts flies, which may lead to tapeworm infestation. For this reason it is desirable to place the pans in which the milk is fed in a new location each day. Also, during the coldest months it is difficult to get the chickens to drink enough milk. This difficulty, however, may be overcome in part by mixing some of the milk with a portion of the mash, all that the birds will consume in about 15 minutes, to make a crumbly wet mash, and feeding it once a day.

It is often possible to use relatively large quantities of home-grown grain by feeding a so-called mixed protein-vitamin concentrate or high-protein mash with it. Mixed protein-vitamin concentrates and high-protein mashes may be purchased from local feed dealers, or the poultryman may have them mixed according to his formulas.

A mixed protein-vitamin concentrate, which may be used in a number of different ways, may be prepared according to the following formula:

MIXED PROTEIN-VITAMIN CONCENTRATE

Ingredient	*Parts, by weight*
Alfalfa-leaf meal	25
Dried skim milk or dried buttermilk	20
Fish meal or meat scrap (or both in any proportion)	20
Soybean meal	10
Corn-gluten meal	5
Linseed meal (old process)	5
Steamed bonemeal	10
Ground limestone	1
Salt mixture [1]	2
Cod-liver oil [2]	2
Total	100

[1] A mixture of 100 pounds of common salt and 1.7 pounds of anhydrous manganous sulfate (or 2.5 pounds of manganous sulfate tetrahydrate).

[2] Or 0.45 part, by weight, of fortified cod-liver oil or other fish oil that contains at least 400 A. O. A. C. chick units of vitamin D and 3,000 International Units of vitamin A per gram.

By mixing equal weights of this mixed protein-vitamin concentrate and any ground grain, an excellent all-mash starting and growing diet may be prepared. An equally good starting and growing mash, with which grain is to be fed, may be made by mixing 55 pounds of this mixed protein-vitamin concentrate with 45 pounds of any ground grain.

A very good all-mash diet for laying and breeding stock may be prepared according to the following formula:

ALL-MASH DIET FOR LAYING OR BREEDING STOCK

Ingredient	*Parts, by weight*
Mixed protein-vitamin concentrate	29.5
Any ground grain	68.0
Ground limestone or oystershell	1.7
Cod-liver oil	.8
Total	100.0

Also, an excellent mash, for laying or breeding stock, with which grain is to be fed may be mixed as follows:

MASH FOR LAYING OR BREEDING STOCK

Ingredient	*Parts, by weight*
Mixed protein-vitamin concentrate	55.0
Any ground grain	39.5
Ground limestone or oystershell	3.7
Cod-liver oil	1.8
Total	100.0

If the birds have access to plenty of sunshine the cod-liver oil may be omitted from the last formula. And, if desired, the mixed protein-vitamin concentrate, whole grain, and limestone or oystershell grit may be fed in separate hoppers, thus making it unnecessary to grind any of the grain or to do any mixing.

In the feeding of laying stock a high-protein mash may be used to advantage, especially when good range is provided. When such mashes are used, whole grain and limestone or oystershell grit are kept before the chickens in separate hoppers. The following high-protein mashes may be mixed and fed:

HIGH-PROTEIN MASH NO. 1

Ingredient	*Parts, by weight*
Ground yellow corn	12
Wheat middlings or shorts	35
Fish meal or meat scrap (or a mixture of the two in any proportion)	30
Dried skim milk or dried buttermilk	10
Alfalfa-leaf meal	10
Salt	1
Cod-liver oil	2
Total	100

HIGH-PROTEIN MASH NO. 2

Ingredient	*Parts, by weight*
Wheat middlings or shorts	33
Meat scrap or fish meal (or a mixture of the two in any proportion)	20
Soybean meal	20
Dried skim milk or dried buttermilk	10
Alfalfa-leaf meal	10
Ground limestone or oystershell	2
Steamed bonemeal	2
Salt	1
Cod-liver oil	2
Total	100

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